Non-linear Regulation of Power Quality within a Multi-Source Microgrid

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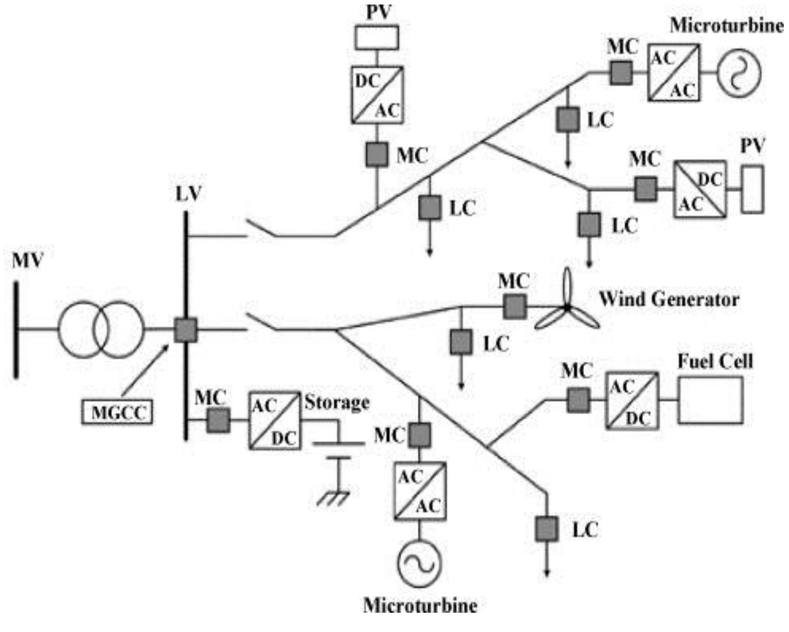
Research Objective: To develop a control strategy to guarantee power quality in multi-source microgrids consisting of multiple renewable energy resources (RER) – solar, wind, etc.

Introduction/Motivation

- **Definition:** A Microgrid (MG) is a localized grouping of electrical sources and loads that can operate connected to a centralized grid (macrogrid) or disconnected from the grid, and operating autonomously (islanded).
- MGs are important because they integrate renewable sources (lower emissions), yield higher transmission efficiency, provide peak-shaving capability and improved supply security.
- MGs have improved power quality characteristics – lower harmonic content in real and reactive power.
- Islanded MGs present new technical challenges in effective power flow management, grid protection and stability, and automatic disconnection/reconnection.
- Currently, the technical issues affecting system reliability have been studied for a single RER scenario.
- However, practical MGs would have more than one RER.

Methodology

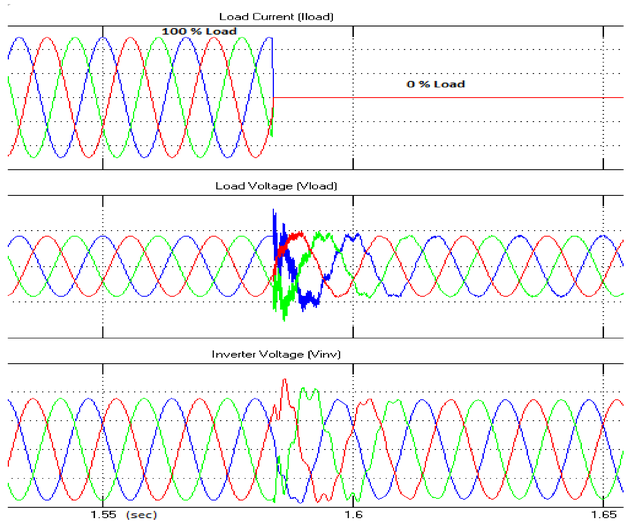
- An industry standard (CERTS*) architecture based MG model is being developed in MATLAB® .
- Formulated as a RSP*, power flow control is implemented using state-feedback and DSMC*.
- The Lyapunov Direct method is used to guarantee system stability.
- Currently incorporating realistic source models into MG simulation.



CERTS-based multi-source MG model

(Source: http://www.sciencedirect.com/science/article/pii/S0360544211002155)

Results



Effect of instantaneous load change (100% to 0%) on load voltage and RER inverter voltage.

Conclusions

- Harmonic content < 0.1%; near-zero transient coupling between real and reactive power for single RER scenario.
- **Research Goal:** Replicate performance for a multisource MG system.

***CERTS:** Consortium for Electric Reliability Technology Solutions, **RSP:** Robust Servomechanism Problem, **DSMC:** Discrete Sliding Mode Controller*